

CLAIMS

- 1) Apparatus (1) for opening and closing a door (2) which is arranged on a vehicle (3) so that it can slide in a door opening (4) in the vehicle (3), the apparatus comprising:
- 5 a) an engaging element (5) connected to the door (2),
b) a drive wheel (6) designed to act upon the engaging element (5),
c) a transmission (7) operatively connected to the drive wheel (6), the transmission (7) being designed to transmit power to the drive wheel (6) via at least a first gear and a second gear so that the drive wheel (6) can be driven in a
10 first gear and a second gear, the first gear being a higher gear and the second gear being a lower gear,
d) a position sensor (8) connected to the sliding door (2) or arranged in the door opening (4) of the vehicle (3) and designed to detect when the sliding door (2) has reached a predetermined position in the door opening, the said sensor (8)
15 being operatively connected to the transmission (7), so that the transmission (7) changes gear from the first gear to the second gear when the door (2), in moving towards a closed position, reaches the predetermined position.
- 2) Apparatus according to Claim 1, *characterised in that* the transmission furthermore
20 has a neutral position so that the drive wheel (6) can rotate freely.
- 3) Apparatus according to Claim 1 or 2, *characterised in that* the engaging element (5) comprises a cable (5) designed to run around pulleys (10) arranged on the vehicle (3) and around the drive wheel (6), that the transmission (7) is arranged in a housing (11)
25 and that the drive wheel (6) is arranged outside the housing (11) of the transmission (7).
- 4) Apparatus according to Claim 1 or 2, *characterised in that* the engaging element (5) comprises a gear rack (12) and that the drive wheel (6) is a pinion.

- 5) Apparatus according to any one of Claims 1 to 3, *characterised in that* the position sensor (8) is operatively connected to the transmission (7) in that when the door (2), in moving towards the closed position of the door (7), reaches the predetermined position, the position sensor (8) is designed to act upon a control device (13) for the transmission (7).
- 6) Apparatus according to Claim 5, *characterised in that* the control device (13) is designed to change from the first gear to the second gear when the position sensor (8) closes or breaks an electrical circuit.
- 7) Apparatus according to Claim 6, *characterised in that* the transmission (7) is a gearbox (7) which comprises:
- a) an input drive shaft (15),
 - b) on the input drive shaft (15), a first gearwheel (16),
 - c) on the input drive shaft (15), a second gearwheel (17), which is smaller than the first gearwheel (16) so that the first gearwheel (16) constitutes a larger gearwheel and the second gearwheel (17) constitutes a smaller gearwheel,
 - d) an output drive shaft (18)
 - e) on the output drive shaft (18), a third gearwheel (19) meshing with the first gearwheel (16) to produce the first gear,
 - f) on the output drive shaft (18), a fourth gearwheel (20), meshing with the second gearwheel (17) to produce the second gear, the said fourth gearwheel (20) being larger than the third gearwheel (19), so that the third gearwheel (19) constitutes a smaller gearwheel and the fourth gearwheel (20) constitutes a larger gearwheel.
- 8) Apparatus according to Claim 7, *characterised in that* the control device is designed to control the transmission of torque from the input drive shaft (15) to the output drive shaft (18) either via the first gearwheel (16) and the third gearwheel (19) or via the second gearwheel (17) and the fourth gearwheel (20).

- 9) Apparatus according to Claim 8, *characterised in that* the output drive shaft (18) is a hollow shaft (18) and that the control device (13) comprises:
- a) a wedge device (21) which is arranged inside the drive shaft (18) and is
5 moveable in the drive shaft (18) in the axial direction of the drive shaft (18),
 - b) a first coupling between the output drive shaft (18) and the third gearwheel (19), the coupling comprising coupling elements (23a) arranged in the output drive shaft (18) and designed to be pressed radially outwards through openings (24a) in the output drive shaft (18) to engage with the third gearwheel (19), so
10 that the output drive shaft (18) is thereby torsionally locked to the third gearwheel (19), and the coupling elements (23a) being designed to interact with the wedge device so that the wedge device (21) can press the coupling elements (23a) radially outwards,
 - c) a second coupling between the output drive shaft (18) and the fourth gearwheel (20), the second coupling comprising coupling elements (23b) which are
15 arranged in the output drive shaft (18) and are designed to be pressed radially outwards through openings (24b) in the output drive shaft to engage with the fourth gearwheel (20), so that the output drive shaft (18) is thereby torsionally locked to the fourth gearwheel (20), and the coupling elements (23b) being
20 designed to interact with the wedge device (21) so that the wedge device (21) can press the coupling elements (23b) radially outwards,
 - d) means for displacing the wedge device (21) axially in the output drive shaft (18), so that the wedge device (21) can actuate either the first coupling or the second coupling.
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- 10) Apparatus according to claim 9, *characterised in that* the means of the control device (13) for displacing the wedge device axially comprise:
- a) a shuttle (27) moveable in a direction perpendicular to the axial direction of the drive shaft (18),

- b) on either side of the shuttle (27) an electromagnet (28) which is designed to attract the shuttle (27),
- c) on the wedge device (21), a pin (29),
- d) on the shuttle (27), a first groove (30) having an extension both parallel to the
5 output drive shaft and perpendicular thereto and in which first groove the pin
(29) of the wedge device (21) is designed to engage,
- e) at least one fixed guide plate (31) having a second groove (32) having an
extension parallel to the output shaft (18), and in which second groove the pin
(29) of the wedge device (21) is arranged so that movement of the shuttle (27)
10 perpendicular to the axial direction of the drive shaft (18) displaces the wedge
device (21) axially in the output drive shaft (18).
- 11) Apparatus according to Claim 10, *characterised in that* the position sensor (8) is
connected to the electromagnets so that each electromagnet (28) is activated or
15 deactivated as a function of the position of the sliding door (2).
- 12) A vehicle (3) having a body (33), the vehicle body (33) being designed so that a door
opening (4) is defined by the body (33) and a door (2), the door (2) being designed to
slide in the door opening (4) between an open position of the door (2) and a closed
20 position, and the vehicle (3) further comprising an apparatus for opening and closing
the sliding door (2), the said apparatus comprising:
- a) a cable (5) which is connected to the door (2) and is designed to run around
pulleys (10) arranged on the vehicle (3),
- b) a drive wheel (6) designed to act on the cable (5),
- 25 c) a transmission 7, preferably a gearbox (7), the transmission (7) being
operatively connected to the drive wheel and being designed to transmit power
to the drive wheel (6) via at least a first gear and a second gear so that the drive
wheel (6) can be driven in a first gear and a second gear, the first gear being a
higher gear and the second gear being a lower gear,

- d) a position sensor (8) which is connected to the sliding door (2) or arranged in the door opening (4) of the vehicle (3) and which is designed to detect when the sliding door (2) has reached a predetermined position in the door opening (4), the sensor (8) being operatively connected to the transmission (7), so that the transmission (7) changes gear from the first gear to the second gear when the door (2), in moving towards a closed position, reaches the predetermined position.
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- 13) Vehicle according to Claim 12, *characterised in that* the transmission (7) furthermore has a neutral position so that the drive wheel (6) can rotate freely
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- 14) Vehicle according to Claim 13, *characterised in that* the transmission (7) is arranged in a housing (11) and that the drive wheel (6) is arranged outside the housing (11) of the transmission (7).
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- 15) Method of fitting an apparatus (1) for opening and closing a door (2), the method comprising the following steps:
- a) providing a vehicle (3) with a door opening (4) in which a door (2) is designed to slide between an open position and a closed position,
- 20 b) providing a cable (5) together with pulleys (10) intended for the cable (5),
- c) fitting said cable (5) and pulleys (10) to the vehicle (3) so that the cable (5) is arranged on the vehicle (3) to run around the pulleys (10),
- d) providing a drive wheel (6),
- e) fitting the drive wheel (6) to the vehicle (3) for interaction with the cable (5),
- 25 f) providing a transmission (7) having a first gear and a second gear,
- g) fitting of the transmission (7) in connection with the drive wheel (6) so that the transmission (7) is operatively connected to the drive wheel (6), so that the drive wheel (6) can be driven in a first gear and a second gear,
- h) providing a control device,

- i) fitting of the control device in connection with the transmission (7) so that the control device can act on the transmission (7) in order to change its gear from the first gear to the second gear,
 - j) providing a position sensor (8),
 - 5 k) fitting of the position sensor (8) in the door opening (4) and establishing of a connection between the position sensor (8) and the control device so that the control device is activated by the position sensor (8) when the sliding door (2) has reached a certain position.
- 10 16) Method according to Claim 15, *characterised in that* the transmission (7) has a neutral position so that the drive wheel (6) can be driven in a first gear and a second gear or can rotate freely in a neutral position.